A quantity-based approach to constructing climate risk hedge portfolios

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Discussion by Michael Barnett (ASU)

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Summary of the paper

Authors provide novel method for constructing climate risk hedges

- Focus on local rather than global climate shocks
  - captures quantity movements that don't create price movements
  - use mutual fund equity holdings and fund adviser location
- Perform out-of-sample tests using global climate shocks
- Compare results to alternative hedge construction measures

Main results of their analysis:

- quantity-based approach has highest average hedge performance ...
  - Fatalities/Injuries measure is positive for all targets
  - Indemnities, Extreme Temp., CSR Reports positive for most.
- Results robust, portfolios responsive to multiple types of climate risks
- Method effectively constructs macro hedges as well

Summary of the paper

Why is this an important contribution?

- Not obvious how to measure and hedge “climate change risk”
  - physical climate damage risk
  - transition to green economy/stranded assets risk
  - climate policy risk
  - weather risk vs. natural disaster risk vs. climate change risk vs ...
- Limited time series information about climate change risk
  - lots of climate data, limited understanding of economic impacts
  - massive amounts of climate and economic model uncertainty
- This approach confronts these issues using asset prices
  - forward looking nature captures beliefs and expectations
  - heterogeneous risk exposures $\Longrightarrow$ key cross-sectional variation

Some details...

Market clearing defined by

$$Q_A = \int_{i=0}^{i=1} q_A(p_A, \varepsilon_A(i))di = \bar{A}$$

A "local" shock $\omega_A(i)$ is such that

$$\frac{\partial Q_A}{\partial \omega_A(i)} = 0, \quad \frac{\partial p_A^*}{\partial \omega_A(i)} = 0, \quad \frac{\partial q^*}{\partial \omega_A(i)} = \frac{\partial q^*}{\partial \varepsilon_A(i)} \neq 0$$

"Global" shock impacts are then determined by

$$\frac{\partial p_A^*}{\partial \nu_A} \propto \int_{i=0}^{i=1} \frac{\partial q_A}{\partial \varepsilon_A(i)} di$$

Construct the empirical counterparts as follows:

$$ActiveChanges_{f,t}^{l} = \beta^{l} S_{loc(f),t} + \delta_t^{l} + \varepsilon_{f,t}, \quad QP_{S,t} = \sum_{l} \widehat{\beta_{S,t-1}^{l}} (R_t^{l} - R_t^{f})$$

Outline of my comments

Novel insights about value of quantity-based hedge construction.

My comments focus on enhancing climate econ of the analysis...

- Validating the climate component of the analysis
  - Decomposing physical versus transition risk
  - Analyzing the time variation
- Expanding the construction of climate shocks
  - Alternative climate, disaster, economic, and policy measures
  - How good are our measures of global climate shocks?
- Briefly touch on digging deeper on other issues...
  - Interpretation and intuition for method and results

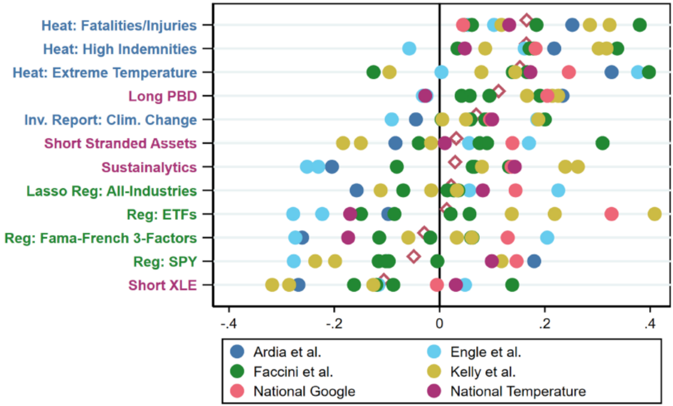
Decomposing performance by climate risk type

Potentially significant value from conditional analysis

- Significant discussion on physical vs. transition risk in literature
  - Krueger et al. (2020): transition/policy most important for institutions
- Help address “surprising” portfolio weight results
  - Portfolio weights and discussion hints at transition risk
  - Recency of date cut-off and impacts also suggests transition
- Answers may already be in the existing results
  - Faccini et al. (2021) and Kelly (2021) provide explicit targets to test
  - Other targets more ambiguous: Engle et al. (2020); Ardia et al. (2020); National Google Searches; National Temperature Deviations
  - Eyeballing main figure hints comparison could be more nuanced

Could provide insight into methodology as well (more later)

Decomposing performance by climate risk type



Source: Giglio et al. (2022)

Times Variation in Hedging Portfolios

Exploring further the times variation of hedging portfolios...

- connects the result to the climate features of the analysis...
  - various empirical break points for climate change risk: Bansal et al. (2019) - **[1970]**; Barnett (2019) - **[1997]**; Bolton and Kacperczyk (2021) - **[2005, 2015]**; Painter (2020) - **[2006]**; Bernstein et al. (2019) - **[2007, 2014]**; Goldsmith-Pinkham et al. (2020) - **[2013]**
  - and theoretical models have highlighted time variation as well: Bansal et al. (2019); Barnett (2022); Barnett et al. (2020, 2021)
- maybe you've already done this, but in my opinion these results would strengthen interpretation of and insights about the results

Time variation provides additional performance test...

and provides a link to climate risk type analysis as well.

Alternative “local” climate shocks

Scope for additional “local” climate risk measures

- Physical measures:
  - local temperature deviations (Barnett, 2022); precipitation (Burke et al., 2015); drought indices (Hong et al., 2019); sea level rise (Baldauf et al., 2020; Goldsmith-Pinkham et al., 2020)
- Disaster measures:
  - wildfires (Issler et al., 2020); hurricanes (Kruttli et al., 2019; Alok et al., 2019); flooding (https://firststreet.org/)
- Policy shock measures:
  - state and local emissions standards; climate-related bond issuance; renewable portfolio and energy production standards; elections
- perhaps future work, but additional measures could help...
  - identify shocks that impact beliefs most, provide “best” hedge
  - provide additional variation related to time and type analysis

Exploring the “global” climate shocks

Is there additional insight on the “global” climate shocks?

- Quality of climate hedge depends on the quality of global shocks
  - quantity-based method valid even if global shocks are not
  - question is whether these hedges really hedge climate risk
- What other global or national level shocks should be considered?
  - Global Agreements (Kyoto, Paris), Major Policies (CPP, RPS), Major Elections, IPCC/UNFCCC Releases, etc.
  - Still an open question of how to best measure this systematic risk
    - Disentangle the various risk types (physical, transition, policy)
    - Needs to be orthogonalized to economic trends
- Refining these targets helps find a “best” climate hedge
- Maybe the quantity-based method can help improve these measures

Returning to the "local" shock assumptions

Some "local" shock criteria are pretty solid:

- "local" shocks impact demand through attention/beliefs ✓
- need to observe affected investors' trading behaviors ✓

Others "local" shock criteria I'd like to see more about:

- "local" shocks only affect a small group of investors
  - Why not regress $\log(\widetilde{G_{t,s}})$ on S_{t,s^-}
  - Confirms results not contaminated with global shock response
  - Record temperatures and significant fatalities are national news
- shifts from local shocks correspond to shifts from global shocks
  - results show they are clearly correlated, but...
  - are fund managers marginal investors? Does it matter?
  - for quantity-based method, no... for optimal hedge, yes
  - moreover, does the fund adviser location make it "worse"?

Fund Adviser Location vs. Climate Beliefs

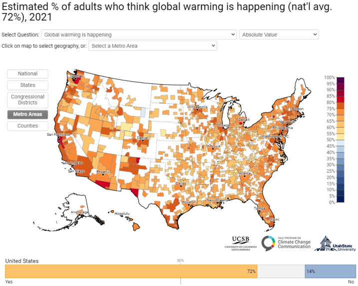
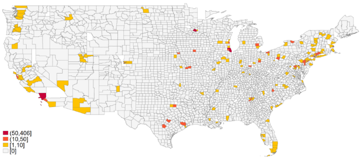


Figure 1: Locations of Mutual Fund Advisers



Source: Yale Climate Opinion Map 2021 and Giglio et al. (2022)

Exploring the quantity-based method further

Author highlight interesting result:

- Use measures that avoid historical data (quantity-based, PBD)
  - even though climate change is slow-moving, long-run risk
  - even though PBD weights contradict(?) quantity-based weights
  - even though XLE avoids historical data as well
- What's drives the result? time-varying risk exposure...

Question: Can we characterize method and breakdown further?

- What assumptions must be violated for things to break down?
- Can the authors highlight an example when it fails?
  - Slow moving physical risk versus fast-moving transition risk?
- Or is there a bounding result on the hedge portfolio quality?

Addressing these points strengthens methodological contribution

Concluding Remarks

Novel method for constructing climate risk hedges

- Use local shocks to isolate quantity-based sensitivity
- Exploit cross-section because time series is limited
- Validate hedge portfolio performance using global shocks, comparing against alternative measures, and test on alternative risks.

Main Comments

- Extend the climate economics of the analysis by
  - examining physical vs. transition risk and time variation, analyzing further the “local” and “global” climate shocks
- Examine further the details of the quantity-based method
  - characterizing methodological features and related results

Really enjoyed opportunity to discuss this paper.
Exciting contribution that should spur important future work.